Momentum, Impulse and Conservation of momentum

Momentum, p is the product of mass and velocity.
vector!!!!!!!

units: kgm/s
p=mv

Impulse - change in momentum - = $F_{net}\,\Delta t$ or the area under the F_{net} - t graph.
$\Delta p=F_{net}\,\Delta t$ if F is constant, area under the graph if not

Law of Conservation of Momentum:
Vector sum of the momentum of all the objects in a system is constant through collisions and explosions if the system is closed and isolated - no external forces or objects in/out.

perfectly elastic collision - kinetic energy and momentum are conserved
inelastic collision - the objects stick together

eg. A 2.0kg cart is moving at 3.0 m/s when it collides with a 1.0kg cart moving at -1.0m/s. If the 2.0 kg cart is moving at 1.0 m/s after the collision,

a) what is the velocity of the 1.0 kg cart after the collision?
b) Was the collision perfectly elastic? If not, how much

energy was lost? In what forms?

c) what was the impulse on the 1.0 kg cart?

d) if they were in contact for 0.20 s, what is the force between the carts?

$$\sum P_i = \sum P_f$$

$$m_A v_A \; (+) \; m_B v_B = m_A v_{Af} + m_B v_{Bf}$$

vector

$$2\,kg\,(3\,m/s) + 1\,kg\,(-1\,m/s) = 2\,kg\,(1\,m/s) + 1\,kg\,(v_{Bf})$$

$$6\,kg\,m/s + -1\,kg\,m = 2\,kg\,m/s + 1\,kg\,v_{Bf}$$

$$\boxed{v_{Bf} = 3.0\,m/s}$$

b) $\sum E_{K_i} \stackrel{?}{=} \sum E_{Kf}$ elastic

$$\frac{1}{2}(2)(3)^2 (+) \frac{1}{2}(1)(-1)^2 \stackrel{?}{=} \frac{1}{2}2(1)^2 + \frac{1}{2}(1)(3)^2$$

not vector

$9J + 0.5J \stackrel{?}{=} 1J + 4.5J$

$9.5J \stackrel{?}{=} 5.5J$ No

4.0J is lost as heat & sound

c) $\Delta p = p_f - p_i = 3\,kgm/s - (-1\,kgm/s)$

$= 4\,kgm/s$

d) $F = \frac{\Delta p}{t} = \frac{4}{0.2} = 20\,N$

Momentum, Impulse Law of conservation of momentum:

Momentum, p is the product of mass and velocity

$P=mv$

units: kgm/s

!!!!VECTOR!!!!!!

Impulse: change in momentum = $F_{net}\Delta t$ = area under the F_{net} - t graph

$\Delta p= F_{net}\Delta t$ if F is constant

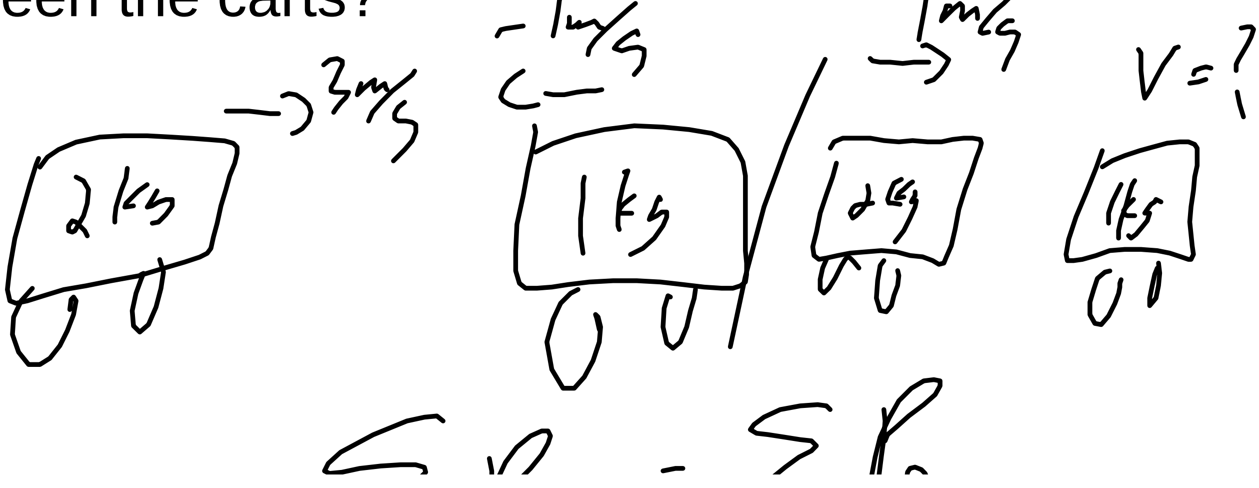
(watch out, W=Fd area under F-d graph
ΔEk = area under F_{net}-d graph)

Law of conservation of momentum:

The VECTOR SUM of all the momentum of all the objects in a system is conserved through collisions and explosions, in a closed, isolated system - no external forces or objects in/out.

eg. A 2.0 kg cart is moving at 3.0 m/s when it collides with a 1.0 kg car moving at -1.0m/s. After the collision, the 2.0 kg cart moves at 1.0 m/s. Determine:

a) velocity of the 1.0 kg cart after the collision.
b) perfectly elastic collision is when no kinetic energy is lost.
   inelastic collision is when they stick together.
   - what the collision of the carts perfectly elastic? If not, how much energy was lost? in what forms?
c) What is the impulse on each cart?
d) if they are in contact for 0.20s, what is the force between the carts?



$m_A v_A$ (+) $m_B v_B = m_A v_{Af} + m_B v_{Bf}$

vector

$2kg(2m/s) + 1kg(-1m/s) = 2kg(1m/s) + 1kg(v)$

$5 m/s = 2m/s + v$

$v = 3.0 m/s$

b) $E_{kA} + E_{kB} \stackrel{?}{=} E_{kAf} + E_{kBf}$ elastic

$\frac{1}{2}(2)(3)^2$ (+) $\frac{1}{2}(1)(-1)^2 \stackrel{?}{=} \frac{1}{2}(2)(1)^2 + \frac{1}{2}(1)(3)^2$

not a vector

$9J + 0.5J \stackrel{?}{=} 1J + 4.5J$

$9.5J \stackrel{?}{=} 5.5J$

No

4.0J was lost as

heat + sound in springs

c) $\Delta p = p_f - p_i = 2(1) - 2(3)$

Δp 2kg cart $= -4.0$ kgm/s

Δp 1kg cart $= +4.0$ kgm/s

d) $F = \frac{\Delta p}{\Delta t} = \frac{4 \text{ kgm/s}}{0.20\text{s}} = \boxed{20N}$